

Title: Function Fun*Multiplication of Whole Numbers and Function Tables***Brief Overview:**

The students will use their knowledge of multiplication, algebra and problem solving to create and solve various multiplication functions. The unit will begin with a review of basic multiplication. The lesson later explores the beginning elements of functions and algebraic thinking. The unit concludes with a summative assessment of student knowledge relating to functions and function tables.

NCTM Content Standards:

Number and Operations

- Understanding numbers and relationships among numbers.
- Understanding meanings of operations

Algebra

- Understanding patterns, relationships and functions.
- Use mathematical models to represent and understand quantitative relationships.

Grade/Level:

Grades 4th – 5th

Duration/Length:

3 Days (Approximately 50 Minutes Each Day)

Student Outcomes:

Students will:

- Multiply whole numbers using a one digit factor by up to a three digit factor using whole numbers 1-1000.
- Create a function table using a one operation (addition, subtraction, multiplication or division) rule.
- Apply the strategies drawing a picture, finding a pattern and writing an equation to solve problems.

Materials and Resources:

- Multiplication and Algebra Fiction Books: 2x2=Boo by Loreen Leedy, Amanda Bean's Amazing Dream by Cindy Neuschwander, Bats on Parade by Melissa Sweet, 7x9=Trouble by Claudia Mills, Safari Park by Steve Bjorkman or any other relevant math fiction books.
- One set of dice (6 sided, 8 sided, 10 sided or 12 sided dice) per team.
- Overhead Projector or Chart Paper
- Dice Multiplication Game Board (SR1)
- Overhead Dice Multiplication Game Board (TR1)
- Overhead Brief Constructed Response – Multiplication (TR2)
- In and Out Handout (SR2)
- Overhead In and Out Handout (TR4)
- Overhead In and Out Handout - Blank (TR3)
- Overhead Brief Constructed Response – Basic Functions (TR5)
- Function Table 1 (SR3)
- Overhead Function Table 1(TR6)
- Function Table 2 (SR4)
- Overhead Function Table 2 (TR7)
- Summative Assessment (SR5)
- In and Out Handout – Blank (SR6)

Development/Procedures:

Lesson 1 Multiplication Review

Pre-assessment – Give each student snap cubes, base ten blocks (single blocks) or rainbow cubes depending upon availability in the classroom. Use the overhead or black board to assist in the initial assessment. Give the students three minutes to create a design using the manipulatives. Provide the students with this time to familiarize themselves with the fun new toys. Pull the class back and tell them that they will be using the blocks to represent several multiplication problems presented on the overhead or blackboard. Provide the students with an example by writing a multiplication problem on the overhead (4x5). Encourage students through open ended questions, such as “How could you show what (4x5) really means?”

For a group of challenged students represent the problem as both an array and by breaking the manipulatives into 4 groups of 5. If you are using a blackboard, use chart paper and draw the groups and arrays for each problem. Next ask the students to use the manipulatives at their desks to represent several multiplication problems (3x3, 4x9, 8x6 etc...) Assess students’ multiplication skills and background knowledge through informal observations of the grouping and arrays that they create.

Launch – Call students to come up to the overhead and show the class how they represented the multiplication problems using the manipulatives. Have as many students as possible use the overhead manipulatives to show the class both the array and grouping possibilities for each of the pre-assessment problems. As the students create the overhead arrays and groups, have one student collect the manipulatives from the teams.

Once the manipulatives have been collected begin reading, 2x2=Boo by Loreen Leedy or another piece of multiplication fiction. After reading, ask the students what multiplication problems they remember from the story. Record their responses on the overhead or blackboard. Compare how the author represented multiplication problems to the ones created by the students.

Teacher Facilitation – Break the class into teams of two based on your informal assessment of multiplication ability and compatibility. Students should be teamed up based on similar ability levels. Have one student pass out a set of random number generators (dice) to each team and have another student pass out a game board to each team (SR1). Place TR1 on the overhead or use a similar piece of chart paper if an overhead is not available. Tell the class to hold their questions until the end of the sample round. Read the directions, located at the bottom of the overhead, with the students. After reading the directions, model a practice round on the overhead. Call on one of the students and ask them to roll one die. Record their roll in the place provided on the game board. Call on a different student and ask them to roll one of the dice and record the result in the space provided in the game board. Provide students with the time necessary to create an array or group the manipulatives in order to present their answers visually.

Call two students up to the overhead and ask them to solve the problem in the space provided. When both students are finished have them reveal their answers and then

record their answer beside the array or grouping and circle it. Assist the students during the example to ensure a correct response. Put a tally mark for both students since they both got the answer correct. After the modeling, ask the students if they have any questions. Remind the students that the point of the activity is solving the problem correctly, not solving it quickly. Visually demonstrate with the overhead game board (TR1) where the students would place the numbers and represent their problems with arrays.

Student Application – Ask the class to record the sample problem on their game board and then draw a picture solving the problem in the space provided. Tell the students that they must draw the picture (array or grouping) in order to receive a point for the problem. Assess understanding by observing students' sample drawings and provide immediate feedback. Tell the students that they have fifteen minutes to play as many rounds as they can. Remind them that there is space available on the back of the handout as well. Monitor student behavior and progress during the game.

After fifteen minutes, have one student collect the dice and game boards. Discuss with the class how the game went. Ask the students what multiplication problems they found most difficult and why. If time permits briefly discuss social aspects of team work and how they could improve next time.

Embedded Assessment – Place TR2 on the overhead (or chart paper) and allow a student to read the brief constructed response question to the class. Tell the class that they have five minutes to complete the constructed response in their journal. Remind the students that the multiplication symbol is the same as saying “groups of”. Assess the responses and supporting drawing for accuracy and judge understanding.

Reteaching/Extension – Allow those students who performed poorly on the embedded assessment extra time and exposure during the reteaching portion. Use a small group setting to assist those students who need reinforcement of basic multiplication. Each student should receive a set of manipulatives (blocks, snap cubes, etc...). Model a sample problem for the students by presenting the problem $4+4+4$ as a broken array. Explain to the students that repeated addition is the same as multiplication and that multiplication is just faster.

Have the students look at $4+4+4$ and ask them how many groups they see. They should respond with 3. Next ask them how many blocks are in each group. The students should respond with four. Ask the students to tell the sum of $4+4+4$. Hopefully they will respond with 12. Explain to them that 3 groups of 4 is 12. Tell them that saying 3 groups of 4 (look back at the display blocks) is the same as saying 3×4 . Provide the students with several sample problems and allow them to use the manipulatives to represent the groups and solve the problem. Spend as much time as necessary to ensure this level of basic understanding.

Development/Procedures:

Lesson 2 Basic Functions

Pre-assessment – Give each student snap cubes, base ten blocks (single blocks) or rainbow cubes depending upon availability in the classroom. Use the overhead or black board to assist in initial assessment. Place twelve manipulatives on the overhead. Ask the class to think about all of the multiplication problems they can think of that have a product of 12. Give the class two minutes to use the manipulatives to represent 12 in as many forms as they can think of. At the end of two minutes ask the students to stand up and give them a minute or two to walk around and see what their peers created. Create one of the possible arrays for 12 and ask students who had that array or grouping to raise their hands. Go through this process with several more arrays and try to pull all of the students into the discussion.

Present another product on the overhead and allow the students to use their manipulatives to show that product as an array or grouping of blocks. As the students solve the problems, observe and pre-assess their basic algebra ability by asking them to create a multiplication problem using 24, 18, 16, etc... manipulatives. Repeat the process of observing their peers and EPR (Every Pupil Response) as long as you feel it is necessary.

Launch – Call on students to come up to the overhead to show the class how they created arrays or grouped the blocks based on the products given. The students will probably be excited and many of them will have different solutions to the multi-factor products. Allow as many students as time permits to present their answers to the class. As the students create their arrays and groupings on the overhead, have one student collect all of the manipulatives. Once the manipulatives have been collected, begin reading, Safari Park by Steve Bjorkman or another piece of algebra fiction. After reading, ask the students if they remember any of the problems from the story. Write the problems on the overhead and ask students if they remember or can find the solution. Record the student attempts and solutions to the problems.

Teacher Facilitation – Break the class into teams of two based on your informal assessment of multiplication skills, algebraic reasoning and compatibility. For this activity it would be a good idea to team lower (students with less multiplication background knowledge) students with higher (students with positive experiences in multiplication) students. Have one student pass out manipulatives (blocks or cubes) and the SR6 handout. Place TR4 on the overhead and call on one student to give you a number between 1 and 12. For example if the student called out 3: [] x [] = [] would change to $3 \times [] = []$. Place the number in the first box on the Overhead In and Out sheet. Call on another student and ask her/him the same thing. Place the number he/she called out into the second box beside the 3. Now your overhead sample should say $3 \times 4 = []$. Ask the class to use the manipulatives to create arrays or grouping that represents 3×4 or 3 groups of 4. Ask the students to draw the array or grouping in the space provided on SR6. As the students work with the manipulatives, assess their

understanding by observing their arrays or groupings. Create the correct array and grouping on the overhead and ask the class to show their handout to their team and peers.

Next present the following problem to the students: $[] \times 5 = 15$. Ask the students what they already know from the problem. Model your thought process for them as this is extremely helpful when teaching problem solving. For example, “Okay I know that I have a total of 15 cubes and that each group of cubes contains 5 cubes, so I need to find out how many groups I have.” Ask the students how many groups of 5 will it take to create 15. Invite the students to use their manipulatives to attempt to solve this problem. Ask the students to draw the array or grouping in the space provided on SR6. Draw the correct array on the overhead and ask everyone that had the answer correct to stand up and bow.

Finally present the following problem to the students: $4 \times [] = 16$. Ask the students to think about what they know already. Model your thought process for them again. For example, “Okay I know I have 4 groups and that I have a total of 16 cubes, so I need to find out how many cubes are in each group.” Invite students to use their manipulatives to create an array or grouping that represents the problem. Ask the students to draw the array or grouping in the space provided on SR6. Have neighbor teams share their answers with each other. Create the array and grouping on the overhead and have everyone that solved the problem give themselves a hand.

Student Application – Have a student pass out one In and Out Handout (SR2) to each team. Tell the students to use their manipulatives to represent and solve each of the problems. Remind the students to draw a picture for each problem that shows how they arranged their manipulatives. Observe the teams of students as they work with the manipulatives and solve the problems. Discuss with teams how they solved the problems and what they thought about as they attempted to solve the problems. Once the majority of the class has completed the activity, use equity sticks or another random name calling system to call one of the students up to the overhead to show the class how they solved the problems on SR2. The teacher may use a transparency of TR3.

Embedded Assessment – Place TR5 the brief constructed response function sheet on the overhead and allow a student to read the question to the class. Tell the class that they have five minutes to complete the constructed response in their journal. Remind the students to draw a picture to support their constructed response. Assess the students’ responses for accuracy and understanding.

Reteaching/Extension – Use a small group setting to assist those students who need reinforcement of basic multiplication. Each student should receive a set of manipulatives (blocks, snap cubes, etc...). For this reteaching portion the students should not use pencil or paper. Place 24 cubes on their desks and ask them not to count the cubes. Have the students focus on you and not their desks or the cubes. Make sure their eyes stay on you. Now tell them to quickly break the cubes into three equal groups. Reinforce that 3 is the number of groups that the total number of cubes are broken into or $3 \times \text{something} = \text{something}$. After the students have broken the 24 cubes into 3 groups they should look at you. Write the following on the overhead or chart paper; so 3 (groups of) \times 8 (number in

each group) = what or $3 \times 8 = []$? The students will either count the total number of cubes or recite the multiplication fact.

The point of this activity is to allow them to find the missing portion of the problem. Repeat this process by removing a factor from the next problem. Write the problem: $7 \times [] = 49$. Allow the students to break the 49 into 7 groups to determine the missing factor. Next remove the first part of the number sentence and have students work together to find the missing factor. Continue this process until the students have achieved a reasonable level of proficiency.

Development/Procedures:

Lesson 3 Function Tables

Preassessment - Give each student snap cubes, base ten blocks (single blocks) or rainbow cubes depending upon availability in the classroom. Use the overhead or black board to assist in initial assessment. Place the Overhead Function Table 1 (TR6) on the overhead and have one student pass out the Student Function Table 1 (SR3) to the students. Allow the students to individually complete the table and draw the array or grouping they used to solve the problem. Remind the students that the function table is similar to what they did the day before but for tables the same rule applies to the entire set of numbers. As the students use the manipulatives to complete the table, pre-assess their understanding of function tables and algebra in general.

Launch – Call on students to assist you (from their desks) in completing the overhead sample function table. As you fill out the table ask students how they know that their answers are correct. Ask them how they found the number of items in each group. Hopefully one student will say that they just had to multiply by four each time. If a student doesn't say that, try to lead them to the rule for this function, $n \times 4$. Explain to them that n is the number that they were given and that they should multiply the number given by four to get the product.

Call on a student to state the rule in words. The student should say you need to multiply by four or something similar. Record both the rule in words and the rule with variables on the overhead and ask the students to revisit their worksheets to add both rules. Tell the students that they are the smartest fourth graders ever because they are already learning about algebra. You might want to tell them that function tables are a lot like algebra and if they think this is easy they will be great at algebra when they get older. Have a student collect sample function table 1 from the class.

Teacher Facilitation – Break the class into teams of two based on your informal assessment of the function tables and compatibility. For this activity it would be a good idea to team lower (students with less multiplication background knowledge) students with higher (students with positive experiences in multiplication) students. Have a student pass out the Function Table 2 (SR4) two each team of students. Put up overhead Function Table 2 (TR7) and ask the students to use manipulatives and their knowledge of multiplication to complete the first table on the function sheet. Tell the students that the space provided is for supporting drawings and calculations.

Once the majority of the class has completed the table give the students one minute to walk around and observe how their peers solved the problem. Ask one team to explain how they came up with their answers to the class. Call on a different team of students to help you write the rule in words and the rule with variables. Remind the students to correct their tables if they made any mistakes.

Student Application – Allow the students to work in their teams to complete the remaining function tables on the handout. Tell the students that they may use the manipulatives to assist them if they need them. As the class works on the function tables,

assess student understanding and assist those students that may be having problems. Again remember to focus on those students who may be having problems with the functions or multiplication. When the majority of the students have completed their function table sheet ask the teams to pick one person to be their representative. Explain to the students that one member of the team will remain with their function table and the other (the representative) will go to other teams to see how they solved the function tables. Have the students move in some kind of pattern (clockwise, by table numbers, etc...) to ensure that the students move to see the function tables and not to play near their friends.

Give the students one minute per team to discuss with their neighbors their problem solving techniques. Monitor student conversations to ensure that the conversations remain focused on math content. Remind the students to explain their thinking which will be required on the summative assessment.

Embedded Assessment – Collect the papers from each team and pass out the handouts to a different team. Call teams up to the overhead to complete one of the function tables and explain why they answered the way that they did. Have students check their neighbors' papers and make corrections if necessary. Assess the accuracy of the function tables and plan to spend extra time with those students needing extra attention during reteaching.

Reteaching/Extension – You may want to work with the students requiring reteaching during specials, recess or after school if possible to ensure as much understanding of the concept as possible. As you work with these students break a function table up into parts and look at each individual function. For example:

3	4	5	6	7	8
15	20				

During reteaching focus first on 3 and 15, and remind the students that we are working with multiplication functions. Ask the students what number multiplied by 3 will give you 15 or if you have 15 total things and you break them into 3 groups how many items will be in each group. Provide the students with block or cube manipulatives to assist in understanding. Hopefully the students will find that there are 5 cubes in each group. Put a (5x) symbol under the 3 and 15 column. Next look at the 4 and 20 column, ask the students to break the 20 cubes into 4 groups. The students will find that there are 5 items in each group.

Discuss with students what happened to each of the factors to find the product. Invite the students to now work with out the total but remind them that we know the number of groups and the number of cubes per group so it is just a simple multiplication problem. Have the students complete the table and explore more tables independently if necessary.

Summative Assessment:

Administer the summative assessment (SR5) and assess accuracy.

Author:

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NAME _____

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Brief Constructed Response - Multiplication

In a well written short essay, prove that (3 x 4), (6 x 2) and (12 x 1) all equal 12 by using appropriate math vocabulary and drawings to support your response.

$$3 \times 5 = \square$$

$$4 \times 6 = \square$$

$$2 \times 8 = \square$$

$$9 \times \square = 27$$

$$2 \times \square = 12$$

$$6 \times \square = 42$$

$$\square \times 5 = 30$$

$$\square \times 8 = 32$$

$$\square \times 4 = 12$$

$$6 \times 9 = \square$$

$$11 \times \square = 33$$

$$\square \times 12 = 120$$

In and Out - Blank

	x		=	

	x		=	

	x		=	

Brief Constructed Response – Basic Functions

In a well written short essay describe how to find the missing factor in the number sentence below. Use appropriate math vocabulary and drawings to support your response.

$$\square \times \square 8 = \square 72$$

Function Table 1

2	3	4	5	6	7	8
8	12	16				

Rule In Words: _____

Rule With Variable: _____

Example :

2	x		=	8
----------	----------	--	----------	----------

Example :

3	x		=	12
----------	----------	--	----------	-----------

Example :

4	x		=	16
----------	----------	--	----------	-----------

Function Table 2

Team Names: _____

Date: _____

1)

2	3	4	5	6	7	8
10	15					

Rule In Words: _____

Rule With Variables: _____

2)

3	4	5	6	7	8	9
18	24					

Rule In Words: _____

Rule With Variables: _____

3)

2	4	6	8	10	12	1
	28	42				

Rule In Words: _____

Rule With Variables: _____

4)

3	5	7	9	11	10	2
24			72			

Rule In Words: _____

Rule With Variables: _____

Dice Multiplication Game Board

NAME _____ SCORE

NAME _____ SCORE

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Directions: Each player rolls one die and records the number in the box. Next draw an array or grouping in the box to solve the problem. Next record and circle your answer beside the array. Check your answer and put a tally mark if correct.

In and Out

$$3 \times 5 = \square$$

$$4 \times 6 = \square$$

$$2 \times 8 = \square$$

$$9 \times \square = 27$$

$$2 \times \square = 12$$

$$6 \times \square = 42$$

$$\square \times 5 = 30$$

$$\square \times 8 = 32$$

$$\square \times 4 = 12$$

$$6 \times 9 = \square$$

$$11 \times \square = 33$$

$$\square \times 12 = 120$$

Function Table 1

2	3	4	5	6	7	8
8	12	16				

Rule In Words: _____

Rule With Variable: _____

Example :

2	x		=	8
----------	----------	--	----------	----------

Example :

3	x		=	12
----------	----------	--	----------	-----------

Example :

4	x		=	16
----------	----------	--	----------	-----------

Function Table 2

Team Names: _____

Date: _____

1)

2	3	4	5	6	7	8
10	15					

Rule In Words: _____

Rule With Variables: _____

2)

3	4	5	6	7	8	9
18	24					

Rule In Words: _____

Rule With Variables: _____

3)

2	4	6	8	10	12	1
	28	42				

Rule In Words: _____

Rule With Variables: _____

4)

3	5	7	9	11	10	2
24			72			

Rule In Words: _____

Rule With Variables: _____

Name: _____ Date: _____

Part One: Selected Response (4 Points)

Circle the missing portion of each number sentence.

1. $[3] \times [] = [24]$ a. 4 b. 5 c. 6 d. 8 e. None of the above
2. $[] \times [7] = [42]$ a. 2 b. 8 c. 6 d. 4 e. None of the above
3. $[9] \times [] = [0]$ a. 1 b. 9 c. 7 d. 2 e. None of the above
4. $[] \times [4] = [44]$ a. 10 b. 11 c. 12 d. 9 e. None of the above

Part Two: Brief Constructed Response (2 Points)

Explain the rule in words and with a variable for the function table below.

3	5	7	9
27	45	63	81

Part Three: Extended Constructed Response (4 Points)

Complete the function table below and in a well written paragraph explain how you know that you completed the table correctly. Use drawings (arrays / groupings) and appropriate math vocabulary to support your written response.

2	4	6	8	10	12
14	28				

In and Out - Blank

	x		=	

	x		=	

	x		=	